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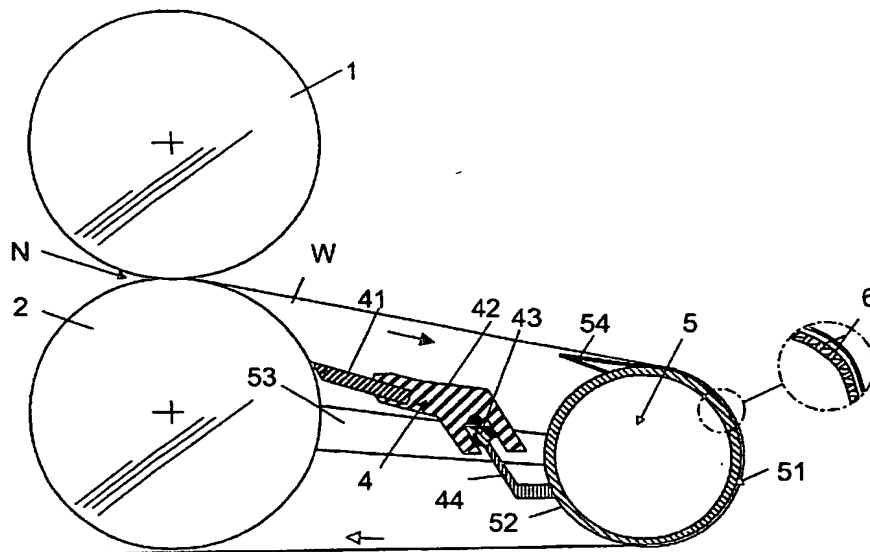
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(54) Title: ARRANGEMENT FOR GUIDING A WEB AND FOR DOCTORING A CALENDER ROLL IN A CALENDER



(57) Abstract: An arrangement in a calender for guiding a paper web (W) from one nip (N) to another nip and for doctoring a calender roll (1, 2). In accordance with the invention, a doctor (4) is supported by a guide means (5) of the web (W), to which guide means (5) the doctor (4) has been attached and which includes at least one stationary and convex guide surface (51) which receives the web from one nip (N) of the calender and over and on which the web is guided towards the other nip of the calender, so that between the guide surface and the web there is a medium layer which carries the web.

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Arrangement for guiding a web and  
for doctoring a calender roll in a calender

- 5 The invention relates to paper and equivalent fibrous web machines and, more specifically, the present invention relates to an arrangement in a calender for guiding a web, advantageously a paper web or an equivalent fibrous web, in the calender from one nip to another nip and for doctoring a calender roll.
- 10 Today, the general aim is to achieve higher running speeds for the web. As a result of this, the risks of roll vibration increase in fibrous web machines. Another problem caused by higher web speeds and partly by roll vibration is the separation of the web from the roll surface, which is accentuated at the dry end of the fibrous web machine when the web dries. Thus, in multi-roll calenders in which the web
- 15 is guided from one nip between a pair of calender rolls to another nip between a pair of calender rolls a guide roll which does not have its own rotation drive, it becomes a problem, when the web separates from the surface of the guide roll, that the rotary movement of the guide roll, which is maintained by the movement of the web in contact with the guide roll, slows down and may even stop. When
- 20 the web comes again into contact with the surface of the guide roll because of the tension caused by the draw of the web, a moment rotating the guide roll is generated but, because of the slowness of the guide roll, a speed difference is produced between the running speed of the web and the circumferential speed of the guide roll, and friction that decelerates the movement of the web is caused. In
- 25 that connection, there is a considerable risk of a web break.

Traditionally, the calender roll is kept clean by means of a doctor, which comprises a doctor blade support means, by means of which a doctor blade is attached to a doctor beam which extends in the axial direction of the calender

30 blade, i.e. in the cross direction, and which is in turn attached by means of support arms to a calender frame or to a bearing pedestal of a calender roll. Because of

this kind of structural arrangement and in particular since other devices are also associated with the calender, such as web guide or reversing rolls and their support structures, the tending platform of the calender must be placed at a considerable distance, even too far from the calender. If the doctor is again placed  
5 on the other side of the calender with respect to the tending platform, maintenance and visual control of the doctor will become a problem.

One object of the invention is to eliminate or at least substantially reduce the above-mentioned problems and drawbacks associated with multi-roll calenders of  
10 conventional fibrous web machines. In particular, it is an object of the invention to provide a novel, more compact structural arrangement for the calender for doctoring a calender roll and for guiding the web between nips between calender rolls. In addition, it is an object of the invention to prevent the web and its guide  
15 means from being only intermittently in contact with each other, which intermittent contact causes varying friction and increases the risk of a web break. It is also an object of the invention to reduce the space needed by the web guide means and the doctor and to assure easier serviceability of them. Further, an object of the invention is to create a guide means and doctor arrangement that is  
20 substantially less expensive than the conventional guide means and doctor arrangements, thus bringing about cost savings.

These objects are achieved by means of the arrangement mentioned at the beginning, the new and inventive basic idea of which arrangement is generally characterized in that the doctor is supported by a web guide means to which the  
25 support means of the doctor and the doctor blade have been attached and which includes at least one stationary, outwards curved, i.e. convex, guide surface which is not in contact with the web and which receives the web from one nip of the calender and over and on which the web is guided towards another nip of the calender, so that between the guide surface and the web there is a medium layer  
30 carrying the web, which layer is advantageously an air film.

- In that connection, it is particularly advantageous in accordance with the invention that the guide means includes a first part, which serves as a convex web guide surface which receives the web from one nip and guides the web in its running direction to a subsequent nip, that the support means of the doctor blade are  
5 connected with a second part of the guide means, which second part is in the guide means on the side opposite to that of the first part, and that the air film covers substantially the entire area of the first part between the guide surface and the web.
- 10 The guide means is formed of an at least partly convex guide plate, the outer surface of which forms a guide surface having a radius of curvature which is selectably variable or invariable. To stiffen the guide plate, it is recommended that a support or stiffening element be arranged between the edges or edge zones of the guide plate, which edges or edge zones extend in the axial direction of the  
15 calender roll, i.e. in the cross direction. In that case, the support means of the doctor are most appropriately attached to the support or stiffening element on the side of the calender roll, so that the doctor blade is directed towards the calender roll while supported by the support means.
- 20 The guide means forms a convex guide surface, which is advantageously a cylindrical surface, which is particularly advantageously a cylindrical surface of a non-rotating web guide or take-out roll, which cylindrical surface faces away from the calender roll. In that connection, the support means of the doctor have been attached to said guide or take-out roll, from which the doctor projects towards the  
25 calender roll. More generally, it may be noted that, in accordance with the invention, the non-rotating cylindrical guide means can be a straight tubular roll, a sectional roll, a bowed one-part take-out or spreader roll, a bowed multiple-part take-out or spreader roll. In accordance with the invention, the guide means having a convex web guide surface may also be a doctor beam of the doctor to  
30 which the support arm of the doctor blade is attached for supporting the doctor towards the calender roll.

When the web runs on the guide surface, there is an air and/or gas film between the web and the guide surface. The movement of the web from the nip towards the guide means can alone cause between the web and the guide surface an air and/or gas flow producing a film.

To enhance the flow of air to the space between the web and the guide surface, the arrangement in accordance with the invention is provided with at least one cross-direction air and/or gas guide member, which, when attached to the arrangement, is located before the web guide means in the running direction of the web and guides the air and/or gas flow to the space between the web and the guide surface.

When the running or circumferential speed of the web is low and the web is porous, a condition may arise in which the movement of the web does not alone produce such an air and/or gas film between the guide surface and the web that carries the web to a sufficient extent. In that case, in addition to the flow coming with the web, it is possible to conduct air and/or gas between the web and the guide surface through air and/or gas flow openings extending through the convex first part of the guide means and bounded within an edge in the shape of a closed periphery, the outer surface of which convex first part forms the guide surface of the web, or through flow passages extending as open to the guide surface, advantageously in a direction transverse to the running direction of the web, i.e. in the cross-direction.

An excessive air and/or gas flow to the space between the web and the guide surface can cause stagnation of air and thus formation of a decelerated air and/or gas layer. To prevent this, part of the air and/or gas film, advantageously the boundary layer of the film near the guide surface, can be passed to the inside of the guide means through the air and/or gas flow openings or passages extending through the convex first part of the guide means, the outer surface of said part forming the guide surface of the web. It must be emphasized further that when the

aim is to maintain an uniform pressure distribution over the entire area of the guide surface, air and/or gas flow(s) in part of the guide surface through the openings or passages to the inside of the guide means and in part of the guide surface through the openings or passages to the space between the guide surface  
5 and the web.

Regarding the advantages of the invention, it may be mentioned that

- rotating guide rolls can be replaced with guide rolls, guide beams or the like which are non-moving with respect to the web, i.e. non-rotating, whereby the  
10 quantity of rotating masses is reduced,
- the web is guided between the nips on a carrying medium layer, such as a film, over guide rolls, guide beams or the like,
- support of the web on the guide rolls, guide beams or the like can be enhanced by additional air and/or gas fed through the shell of a hollow guide roll, a wall  
15 of a hollow guide beam or the like,
- the shape of the guide rolls, guide beams or the like can be optimized to provide an even pressure distribution between the guide surface of the guide roll, guide beam or the like and the web,
- the doctor can be attached to the guide roll, guide beam or the like to the side  
20 of the calender roll that is doctored, thereby providing an integrated structure which is economical as to its costs,
- in the integrated structure the doctor beam can be shaped into a guide means for guiding the web between nips,
- the integrated structure can be disposed in a small space, so that, for example,  
25 the tending platform of the calender can be brought closer to the calender and the calender can always be placed at a location that is easier from the point of view of servicing and control,
- in addition, devices for monitoring the temperature of the rolls and/or the moisture content of the fibrous web can be integrated with the guide roll,  
30 guide beam or the like without any problems.

In the following, the invention will be described by way of example through some of its embodiments and applications, yet not being limited to them, with reference to the appended drawings in which

Figure 1 is a schematic view of a first embodiment of the invention,

5 Figure 2 is a schematic view of a second embodiment of the invention,

Figure 3 is a schematic view of an embodiment of the guide means,

Figure 4 is a schematic view of a second embodiment of the guide means,

Figure 5 is a schematic view of a third embodiment of the guide means,

Figure 6 is a schematic view of a fourth embodiment of the guide means, and

10 Figure 7 is a schematic view of an embodiment of the invention for guiding air to the space between the web and a guide surface or vice versa in the web guide means.

Figs. 1-7 illustrate schematically the arrangement in accordance with the present invention, which arrangement has been arranged in connection with a pair of rolls  
15 1, 2 of a calender for doctoring one calender roll 2 of the pair of rolls and for guiding a web W, which is advantageously a paper web or an equivalent fibrous web, over and on a guide means 5 of the arrangement the pair of rolls 1, 2, which guide means 5 comprises at least one outwards curved, i.e. convex, guide surface  
20 51 for the web W. Thus, the guide surface 51 receives the web W from one nip N and guides the web forward, most appropriately in the running direction of the web to the next nip of the calender (not shown in the figures). When the web runs on the guide surface 51, between the web and the guide surface there is a medium layer which carries the web and which is advantageously an air and/or gas film.  
25 Most appropriately, the film extends over the entire area of the guide surface between the guide surface 51 and the web W. In the following, such a medium layer is referred to by the definition 'air film'.

It must be emphasized that the calender type per se is not essential from the point  
30 of view of the invention, but it is advantageous that the roll stack of the calender comprises at least three calender rolls which form at least two successive nips N,



so that the arrangement in accordance with the invention can be arranged between two nips. It is particularly advantageous that the arrangement is positioned so that it is at least partly aligned with the calender roll 2 which is doctored.

5 In general, the guide means 5 of the arrangement in accordance with the invention includes a first part 51, which comprises at least one stationary, outwards curved, i.e. convex, guide surface 51 which is not in contact with the web W and which receives the web from one nip N of the calender and over and on which the web is guided towards another nip of the calender. In addition, the guide means 5  
10 includes a second part 52 which supports a doctor 4 and to which have been attached support means, or a support arm, 42, 43, 44 of a doctor blade 41 such that the doctor blade 41 is directed towards the calender roll 2 while the doctor blade is supported by the support means 42, 43, 44. These first part 51 and second part 52 of the guide means are typically on the opposite sides of the guide means 5.

15

According to the embodiment shown in Fig. 1, the first part 51 of the guide means 5 is formed of a convex guide plate or guide the outer surface of which forms a convex and non-rotating guide surface 51 directed away from the calender. The shape of the guide surface 51 can be selected freely, so the radius of curvature  
20 may be selectably variable or invariable. It is recommended that the radius of curvature of the convexity of the guide surface shall be variable to provide a uniform pressure distribution between the guide surface and the web. It is also recommended that the curved guide plate is stiffened by means of a support or stiffening element extending in the axial direction of the calender roll 2 which is  
25 doctored, i.e. in the cross direction, which element is advantageously a plate, which is attached between the cross-direction free edges or edge zones 53 of the curved guide plate to form the second part 52 that makes the guide means stronger. In such a guide means 5 provided with a support or stiffening element it is advantageous to attach the support means 42, 43, 44 of the doctor blade 41 to  
30 the support or stiffening element of the guide means 5 on the side of the calender

roll 2 which is doctored, so that the doctor is directed, while supported by the support means, towards the calender roll 2 to be doctored.

In connection with the embodiment shown in Fig. 1 it may be noted that the first part 51 and the second part 52 of the guide means can form together a doctor beam for the doctor 4. In that case, the web W runs over the doctor beam on an air film from a nip N to a subsequent nip and the doctor 4 has been attached to the wall portion of the doctor beam facing towards the calender. It must be emphasized that the cross-sectional profile of the almost semicircular hollow beam shown in Fig. 1 may be a full circle as shown in Figs. 2 and 6 or a quadrangular parallelepiped as shown in Fig. 7. In addition, it is recommended that the radius of curvature of the convexity of the guide surface 51 formed of the first part shall be variable to provide a uniform pressure distribution between the guide surface and the web.

15

In accordance with the embodiment shown in Fig. 2, a guide means 5 is formed of a cylindrical piece, so that a first part 51 forms, in accordance with the basic idea of the invention, an outwards curved, i.e. convex, and non-rotating guide surface 51, which is a cylindrical surface facing away from the calender. In accordance with one embodiment, the non-rotating cylindrical surface is the cylindrical surface of a guide or take-out roll of the web W, which cylindrical surface faces away from the calender roll. In such a guide means formed of a cylindrical piece, the half of the cylindrical piece facing towards the calender forms a second part 52 of the guide means 5, support means 42, 43, 44 of a doctor blade 41 being attached to the second part 52 such that a doctor 4 projects from the guide or take-out roll of the web W formed of a cylindrical piece towards a calender roll 2 which is doctored.

In accordance with the basic idea of the invention, an air or gas flow that produces an air film between the web W and the guide surface 51 can be brought about by the movement of the web alone from the nip N towards the guide means 5.

When the running or circumferential speed of the web W is low and/or the web is porous, a condition may arise in which the movement of the web does not alone produce such an air film between the guide surface 51 and the web W that carries the web to a sufficient extent. In that case, in addition to the air and/or gas flow coming with the web, it is possible to conduct air, which is illustrated with curved arrows in Figs. 3-5, to the space between the web W and the guide surface 51

- through air flow openings 6 which are bounded, as shown in Figs. 3 and 5, as open to the guide surface 51, within an edge in the shape of a closed periphery, or
- through flow passages 6 which extend, as shown in Fig. 4, as open to the guide surface 51, advantageously in a direction transverse to the running direction of the web, i.e. in the cross-direction, across the guide surface 51, so that the edges defining the air flow passage 6 are most appropriately parallel to and spaced from each other,

which air flow openings and passages extend through the convex first part of the guide means 5, the outer surface of which convex first part forms the guide surface 51 of the web.

Regarding the guide surface 51 provided with openings or passages 6, it is noted further that in order to maintain a uniform pressure distribution between the web W and the guide surface 51, the flow of air or gas through the openings or passages can also take place such that the flow is directed in part of the guide surface from between the web W and the guide surface 51 to the inside of the guide means 5 and in part of the guide surface from inside the guide means 5 to the space between the web W and the guide surface 51.

As illustrated in Figs. 1, 2, 6 and 7, the flow of air to the space between the guide surface 51 and the web W can be assured and enhanced by providing the arrangement with at least one cross-direction air guide member 54. Such an air guide member 54 is attached to the arrangement, to achieve the desired effect, in

the running direction of the web W before the guide means of the web such that it guides the air and/or gas coming with the movement of the web W to the space between the web and the guide surface 51. In the embodiments shown in Figs. 1 and 2, the air and/or gas guide member is on the same side of the guide means 5 as the doctor 4 and it is situated between the doctor 4 and the web W, so that it forms a wing-like air guide member.

Reference is made to Fig. 6 and it is noted that in connection with Figs. 1-5 above the invention has been described by means of embodiments and applications in which the first part of the guide means comprises only one convex guide surface 51. When the height of the guide means 5 and, thus, the height of the guide surface is not greater than the diameter of the calender roll 2 which is doctored and which is at least partly aligned with the guide means, the angular deviation of the change of direction experienced by the web W on the guide surface 51 is  $\leq$  180°. It shall be emphasized that the guide means 5 comprising one guide surface is, however, not a necessity from the point of view of the operation of the invention but, in accordance with the invention, the convex guide surface 51 may comprise two or even more outwards curved, i.e. convex, guide surface parts 511, 512 placed one after the other. When the guide means 5 is substantially in the shape of a parallelepiped as shown in Fig. 7 and has two guide surface parts 511, 512 and when the height of the guide means 5 does not exceed the diameter of the calender roll 2 which is doctored and which is at least partly aligned with the guide means, the angular deviation of the change of direction experienced by the web W on both guide surfaces 51 is  $\leq 90^\circ$ .

25

Reference is made to Figs. 3-6, which show the guiding of air and/or gas in the guide means 5 to the space between the web W and the guide surface 51 and vice versa from between the web and the guide surface to the inside of the guide means 5. An air and/or gas excessive flow to the space between the web W and the guide surface 51 can cause stagnation of air and/or gas and, thus, formation of a decelerated air film. To prevent this, part of the air film, advantageously the

30

boundary layer near the guide surface 51 of the air film, can be passed to the inside of the guide means 5 through the air flow openings or passages 6 extending through the convex first part of the guide means 5, the outer surface of which first part forms the guide surface 51 of the web W. In the embodiment of Fig. 7, the

5 guide means has a central air cavity,

- in which a constant pressure can be kept to maintain a to-and-fro flow in the flow openings or passages 6,
- into which air and/or gas can be conducted to pass a flow through the flow openings or passages 6 to the space between the web W and the guide surface

10 51, or

- from which air can be sucked to produce an air flow through the air flow openings or passages 6 away from the space between the web W and the guide surface 51.

15 Above, the invention has been described only by way of example by means of some of its embodiments and applications considered to be advantageous. It shall be understood that the invention is not meant to be limited to these only, but variations and modifications are feasible within the scope of protection of the inventive idea defined in the appended set of claims.

## Claims

1. An arrangement in a calender for guiding a web, advantageously a paper web (W) or an equivalent fibrous web, in the calender from one nip (N) to another nip  
5 and for doctoring a calender roll (1, 2), **characterized** in that a doctor (4) is supported by a guide means (5) of the web (W), to which guide means (5) support means (42, 43, 44) of the doctor (4) have been attached and which includes at least one stationary and outwards curved, i.e. convex, web guide surface (51) which receives the web from one nip (N) of the calender and over and on which  
10 the web is guided towards a subsequent nip of the calender, so that between the guide surface and the web there is a medium layer which carries the web and which is advantageously an air film and/or a gas layer.
2. An arrangement as claimed in claim 1, **characterized** in that the guide means  
15 (5) includes a first part (51), which serves as the at least partly convex web guide surface, that the support means, i.e. a support arm, (42, 43, 44) of a doctor blade (41) are attached to a second part (52) of the guide means, which second part is in the guide means on the side opposite to that of the first part, and that the air film and/or the gas layer cover(s) substantially the entire area of the first part between  
20 the guide surface and the web.
3. An arrangement as claimed in claim 1 and/or 2, **characterized** in that the guide surface (51) receives the web from one nip (N) and guides the web in its running direction to the next nip.
- 25
4. An arrangement as claimed in claim 2 and/or 3, **characterized** in that the guide means (5) is formed of an at least partly convex guide plate, an outer surface of which forms the guide surface (51), and of a second part (52), advantageously a plate, of the guide means between edges or edge zones (53) of  
30 the guide plate, which edges or edge zones extend in the axial direction of the

calender roll (1, 2), i.e. in the cross direction, which second part serves as a support or stiffening element of the guide means.

5 5. An arrangement as claimed in any one of claims 2 to 4, **characterized** in that the radius of curvature of the guide surface (51) is selectably variable or invariable.

10 6. An arrangement as claimed in any one of claims 2 to 4, **characterized** in that the first part of the guide means (5) serving as the guide surface (51) is formed of a cylindrical surface.

15 7. An arrangement as claimed in any one of claims 4 to 6, **characterized** in that the support means (42, 43, 44) of the doctor blade (41) have been attached to the support or stiffening element (52) of the guide means (5) on the side of the calender roll (2), so that the doctor blade is directed, while supported by the support means, towards the calender roll.

20 8. An arrangement as claimed in claim 2 and/or 3, **characterized** in that the first part of the guide means (5) serving as the guide surface (51) is formed by a cylindrical surface of a non-rotating web guide or take-out roll, which cylindrical surface faces away from the calender roll (2).

25 9. An arrangement as claimed in claim 8, **characterized** in that the support means (42, 43, 44) of the doctor blade (41) have been attached so that they project from the guide or take-out roll of the web (W) towards the calender roll (2).

30 10. An arrangement as claimed in any one of claims 2 to 9, **characterized** in that the flow of air and/or gas which produces an air and/or gas film to the space between the web (W) and the guide surface (51) is brought about by the movement of the web from the nip (N) towards the guide means.

11. An arrangement as claimed in any one of claims 2 to 10, **characterized** in that air flows between and from between the web (W) and the guide surface (51) through air and/or gas flow openings or passages (6) extending through the convex first part of the guide means (5).

5

12. An arrangement as claimed in any one of claims 2 to 10, **characterized** in that in order to prevent formation of a stagnated or decelerated air and/or gas layer, part of the air and/or gas film, advantageously a boundary layer near the guide surface (51) of the air and/or gas film, can be passed from between the web (W) and the first part (51) of the guide means (5) through the air flow openings or passages (6), which extend through the convex first part of the guide means (5), to the inside of the guide means.

10

13. An arrangement as claimed in any one of claims 10 to 12, **characterized** in that the air and/or gas flow openings (6), which are open to the guide surface, are bounded by edges in the shape of a closed periphery, which edges are advantageously polygonal, circular, elliptical or the like.

15

14. An arrangement as claimed in any one of claims 10 to 12, **characterized** in that the air and/or gas flow passages (6) extend substantially in the cross direction across the guide surface (51), and that the edges bounding each air and/or gas flow passage, which is open to the guide surface (51), are substantially parallel and spaced from one another.

20

15. An arrangement as claimed in any one of claims 1 to 14, **characterized** in that the guide means (5) of the arrangement has been selected from a group including: a straight tubular roll; a sectional roll, a bowed one-part take-out or spreader roll; a bowed multiple-part take-out or spreader roll.

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16. An arrangement as claimed in any one of claims 1 to 15, **characterized** in that the guide means (5) of the arrangement, which has a guide surface (51) for

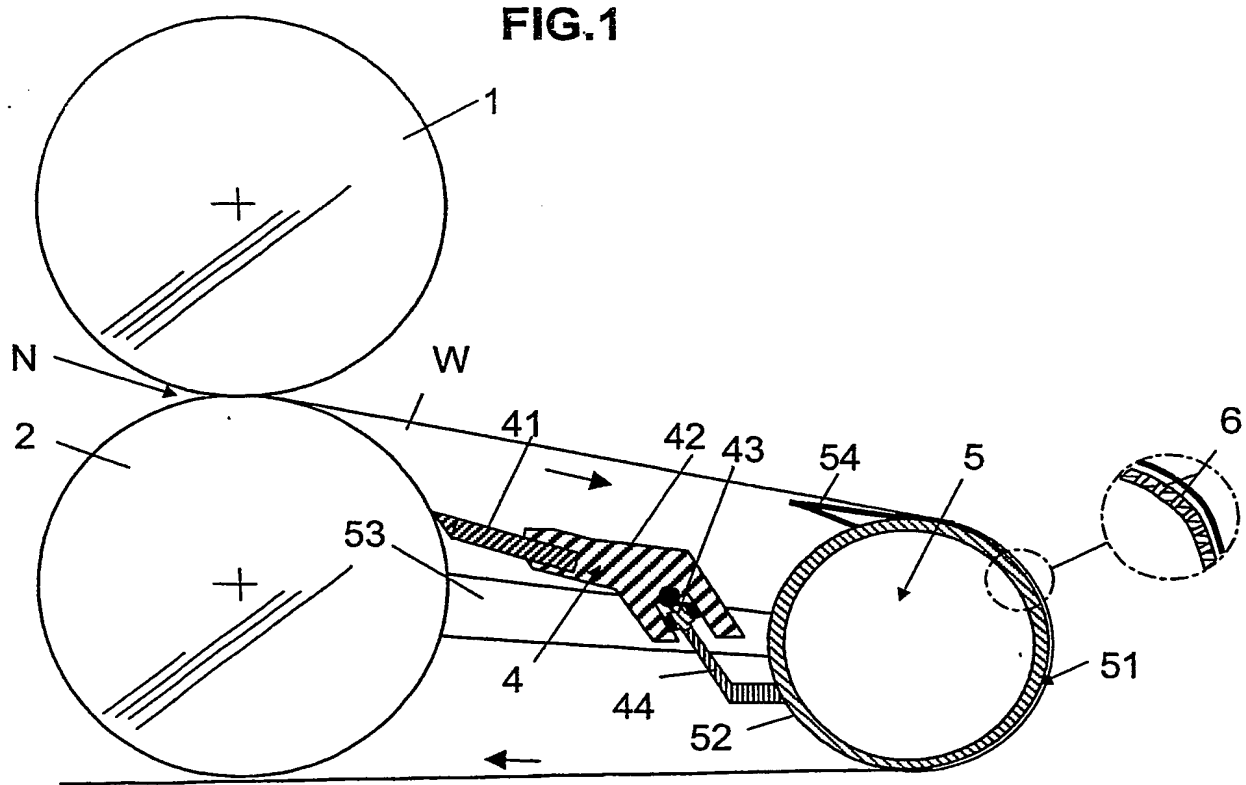
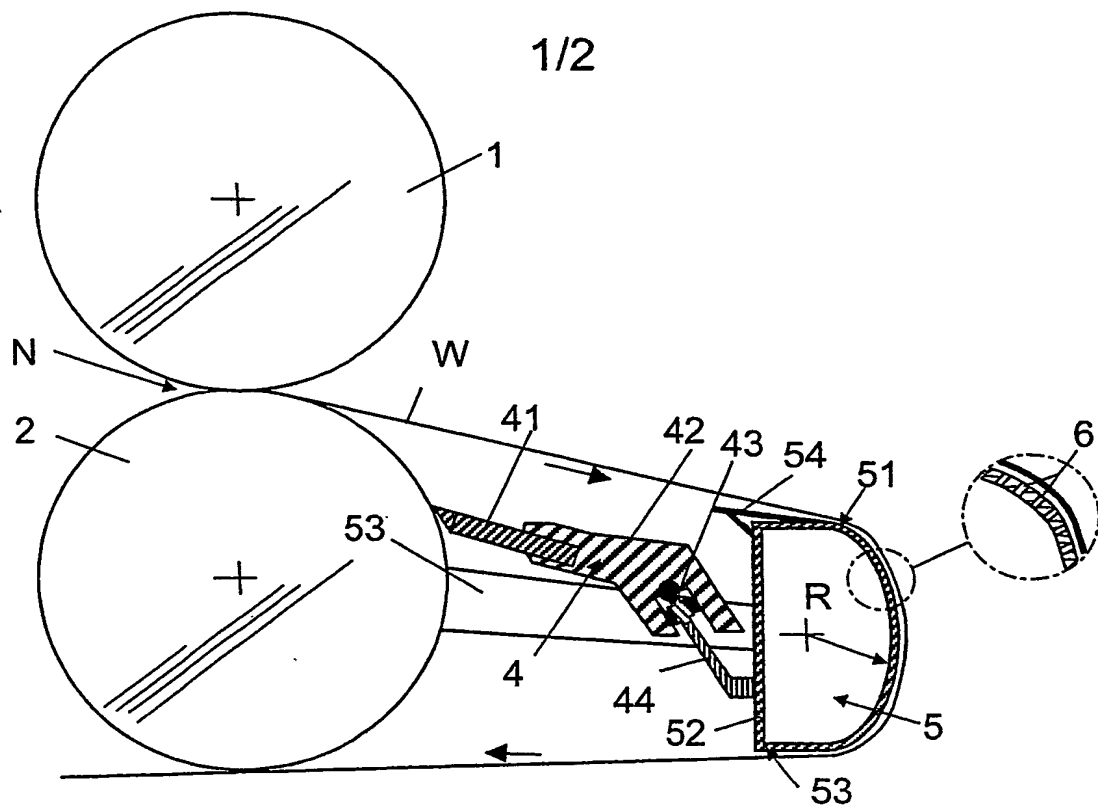
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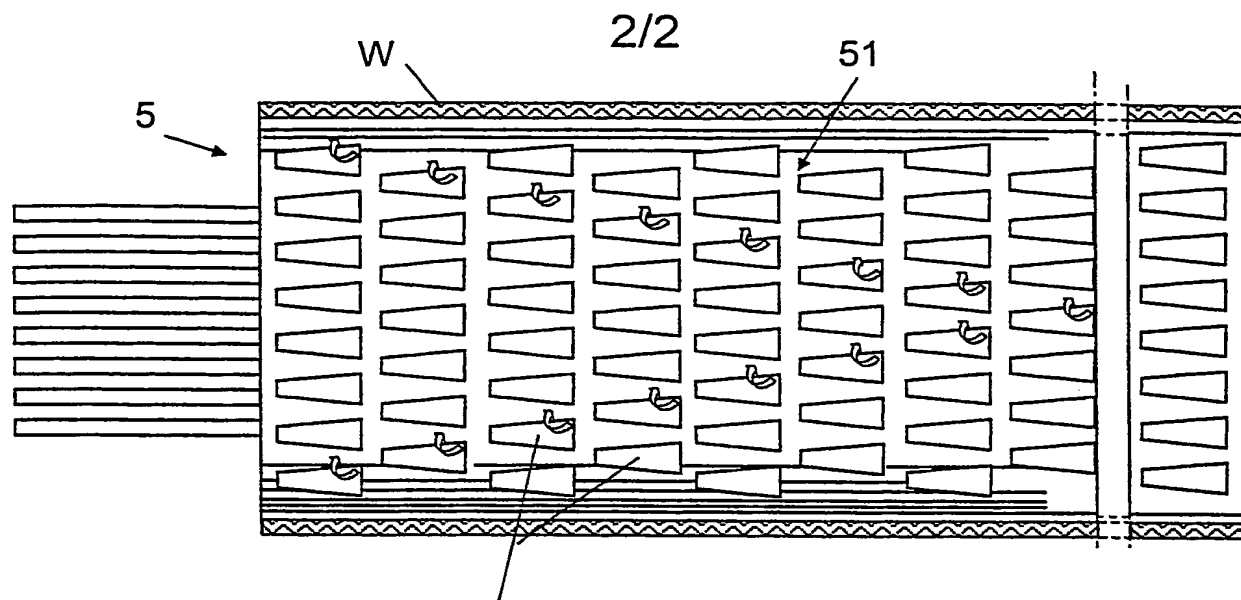


the web (W), is formed of a doctor beam of the doctor (4), to which doctor beam the support arm (42, 43, 44) of the doctor blade (41) has been attached.

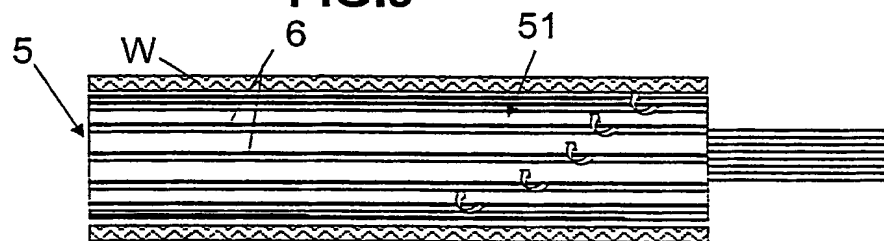
17. An arrangement as claimed in any one of claims 1 to 16, **characterized** in  
5 that the convex guide surface (51) has at least two outwards curved guide surface parts (511, 512) placed one after the other.

18. An arrangement as claimed in any one of claims 1 to 17, **characterized** by at  
least one cross-direction air guide member (54) which, as attached to the  
10 arrangement, is situated in the running direction of the web (W) before the web guide means (5) and which guides air and/or gas to the space between the web and the guide surface (51).

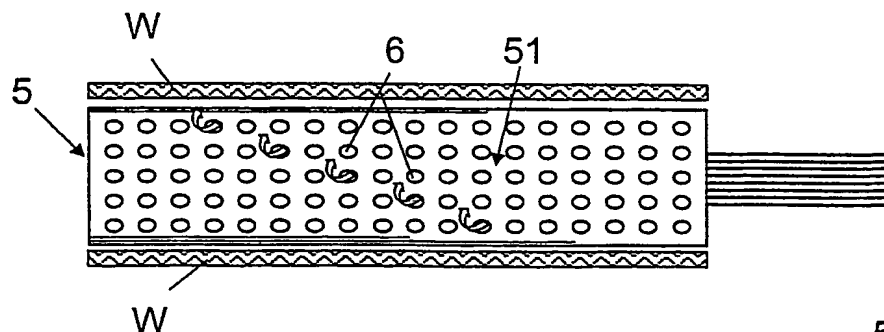




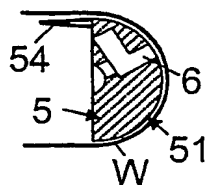
**FIG. 3**



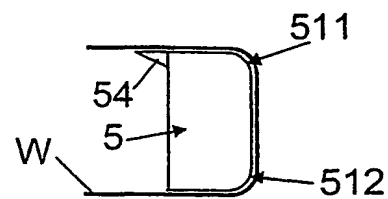
**FIG. 4**



**FIG. 5**



**FIG. 6**



**FIG. 7**

# INTERNATIONAL SEARCH REPORT

International Application No

PC 01 03/00551

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 D21G1/00 D21G3/02

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 D21G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 199 61 666 A (VOITH PAPER PATENT GMBH ;HAINDL PAPIER GMBH & CO KG (DE)) 5 July 2001 (2001-07-05) column 1, line 14 - line 20 column 2, line 35 - line 41 -----	1-18

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

### ° Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

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Date of the actual completion of the international search

11 November 2003

Date of mailing of the international search report

05.12.03

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**Effect on patent family members**

PC 03/00551

Patent document  
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Publication date

Patent family member(s)

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05-07-2001

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